ador WELDING

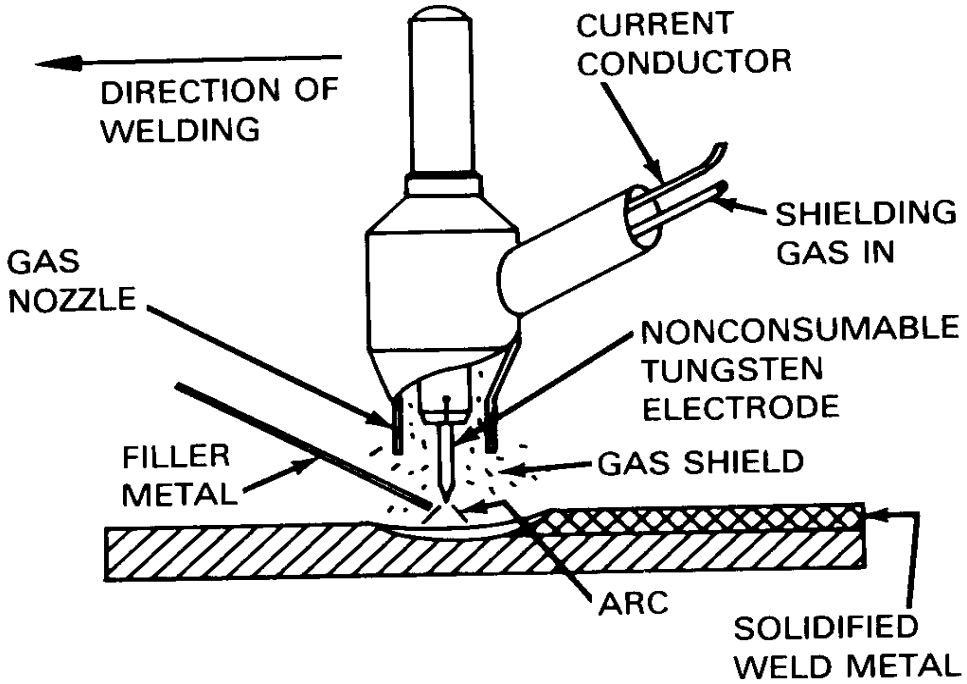
TIG WELDING

Introduction

- What is TIG?
  - Tungsten Inert Gas
- Also referred to as GTAW
  - Gas Tungsten Arc Welding
- In TIG welding, a tungsten electrode heats the metal you are welding and gas (most typically Argon) protects the weld from airborne contaminants

Introduction

- TIG welding uses a non-consumable tungsten
- Filler metal, when required, is added by hand
- Shielding gas protects the weld and tungsten



Advantages

- Welds more metals and metal alloys than any other process
- High quality and precision
- Aesthetic weld beads
- No sparks or spatter
- No flux or slag
- No smoke or fumes
- Precise control of arc and fusion characteristics
- Easily automated
- Used in all positions
- Intricate geometries weldable

Disadvantages

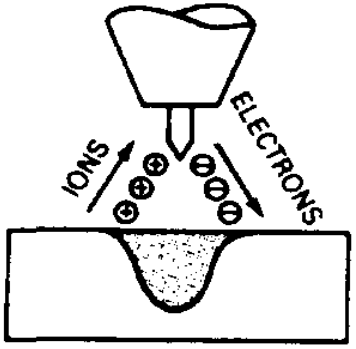
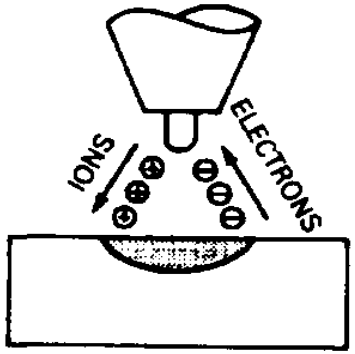
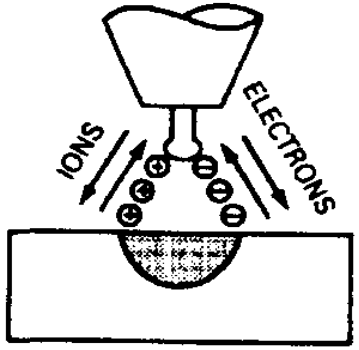
- Less economical than consumable electrode processes for sections thicker than 3/8 inch
- Lowest deposition rate of all arc processes
- Tungsten inclusions
- Higher operator skill Required
- Sensitive to drafts

Tungsten electrode Selection Chart

Tungsten Electrode Selection Chart

Tig Mode	Tungsten Type	Colour
AC	Pure	Green
DC or AC/DC	Ceriated 2%	Grey
DC or AC/DC	Lanthanated 1%	Black
DC or AC/DC	Lanthanated 1.5%	Gold
DC or AC/DC	Lanthanated 2%	Blue
DC	Thoriated 1%	Yellow
DC	Thoriated 2%	Red
AC	Zirconiated 1%	White

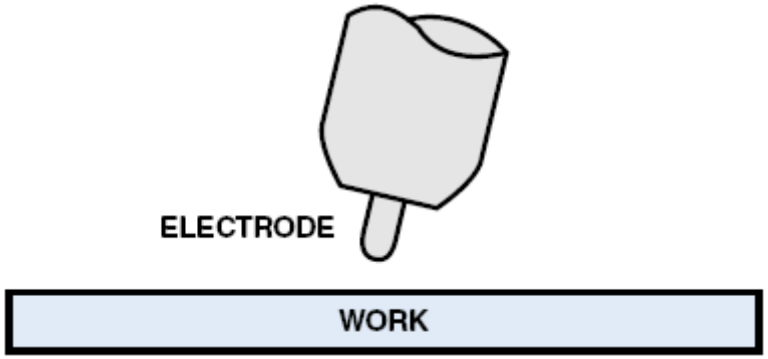
Effects of Polarity

CURRENT TYPE	DCEN	DCEP	AC (BALANCED)
ELECTRODE POLARITY	NEGATIVE	POSITIVE	
ELECTRON AND ION FLOW / PENETRATION CHARACTERISTICS			
OXIDE CLEANING ACTION	NO	YES	YES-ONCE EVERY HALF CYCLE
HEAT BALANCE IN THE ARC (APPROX.)	70% AT WORK END 30% AT ELECTRODE END	30% AT WORK END 70% AT ELECTRODE END	50% AT WORK END 50% AT ELECTRODE END
PENETRATION	DEEP; NARROW	SHALLOW: WIDE	MEDIUM
ELECTRODE CAPACITY	EXCELLENT e.g., 1/8 in. (3.2 mm) 400 A	POOR e.g., 1/4 in. (6.4 mm) 120 A	GOOD e.g., 1/8 in. (3.2 mm) 225 A

Techniques for Basic Weld Joints

Arc Length

- Arc length normally one electrode diameter, when AC welding with a balled end electrode
- When DC welding with a pointed electrode, arc length may be much less than electrode diameter



Techniques for Basic Weld Joints

Manual Torch Movement

- Torch and filler rod must be moved progressively and smoothly so the weld pool, the hot filler rod end, and the solidifying weld are not exposed to air that will contaminate the weld metal area or heat affected zone
- When arc is turned off, postflow of shielding gas should shield the weld pool, electrode, and hot end of the filler rod

TIG Shielding Gases

Argon

- Good arc starting
- Good cleaning action
- Good arc stability
- Focused arc cone
- Lower arc voltages
- 10-30 CFH flow rates

Helium

- Faster travel speeds
- Increased penetration
- Difficult arc starting
- Less cleaning action
- Less low amp stability
- Higher arc voltages
- Higher flow rates (2x)
- Higher cost than argon

TIG Shielding Gases

Argon/Helium Mixtures

- Improved travel speeds over pure argon
- Improved penetration over pure argon
- Cleaning properties closer to pure argon
- Improved arc starting over pure helium
- Improved arc stability over pure helium
- Arc cone shape more focused than pure helium
- Arc voltages between pure argon and pure helium
- Higher flow rates than pure argon
- Costs higher than pure argon

Points

- Push technique: Aluminum with AC +ve cycle –ve cycle

Electrode +ve ions heavy mass bombard the oxide layer clean the surface

- Push for fast travel speed
- Element transfer high cause of inert gas
- Root Run: Always TIG low speed , control, metal transfer only after arc start and stabilise.(Defect in other processes)
- Automation: orbital TIG
- TIG Brazing with long arc Heat for melting filler metal only

Defects in TIG Welding

- **Burnout:** Heat input control at end and sensitive in Inconel steels
- **No Filler Metal:** filler rod to be fed uniformly
- **Incorrect Filler Metal Size:** non uniform bead
- **Incorrect Amperage:** Lack of fusion
- **Tungsten Inclusion:** W tip touches weld pool(X ray white spot)
- **Porosity:** Tungsten tip blow out, gas and dirt on base plate
- **Undercut:** Amperage
- **Excess Face Reinforcement:** Stress crack

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TIP TIG welding

Disadvantages of Conventional TIG

- Less economical than consumable electrode processes for sections thicker than 3/8 inch
- Lowest deposition rate of all arc processes
- Tungsten inclusions
- Higher operator skill Required
- Sensitive to drafts

Introduction

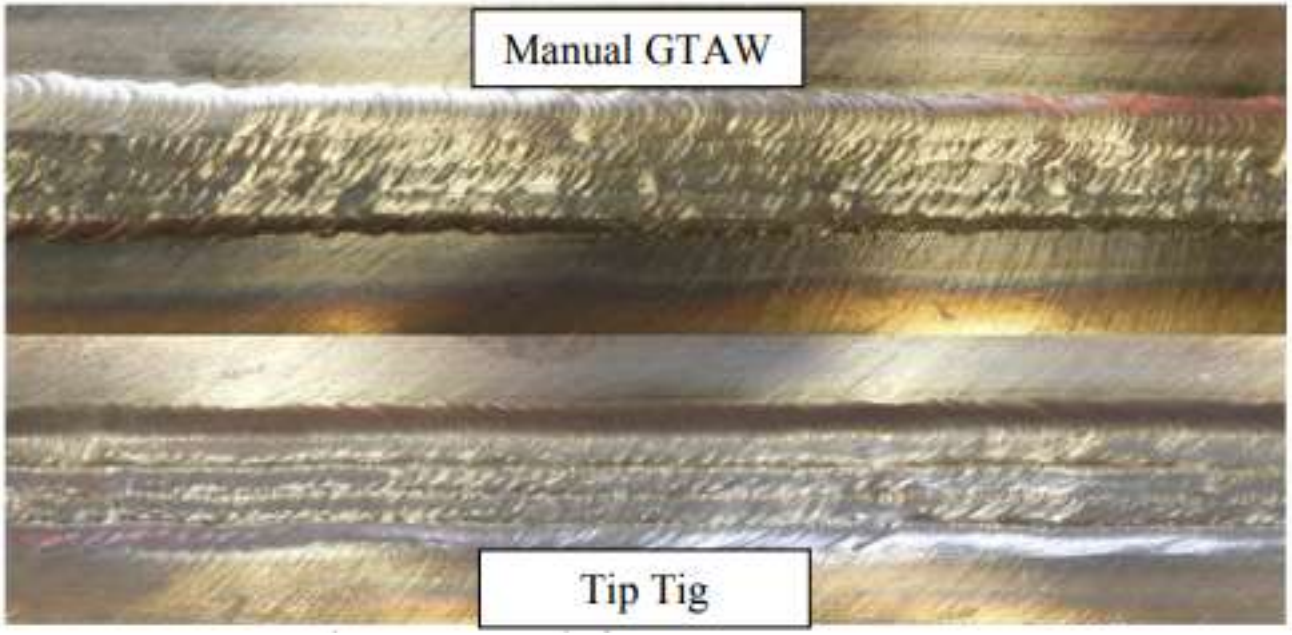
- TIP TIG is a semi-automatic high deposition metal transfer variant of the manual TIG welding (GTAW) process.
- As opposed to the manual GTAW process, in TIP TIG, the continuously fed and sinusoidal stimulated preheated filler metal improves very significantly the deposition rate.
- The automatic TIG wire feeder includes a filler wire agitation mechanism that improves the dynamics of the molten weld pool.
- The agitation appeared to increase fluidity of the weld puddle and help break up impurities and release evolving gases for reduced risk of inclusions and porosity.

Parts

Tip Tig Torch

Wire Feeder

Comparison TIG Vs TIP TIG



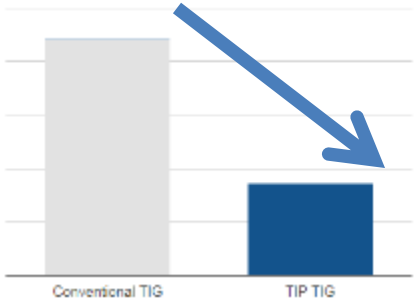
Advantages

300 %
Faster Welding Speeds

400 %
Improvement in Deposition Rate

80 %
Reduced Dilution

Unskilled also can operate



60 %
Reduction in Total Cost

Improved Mechanical properties

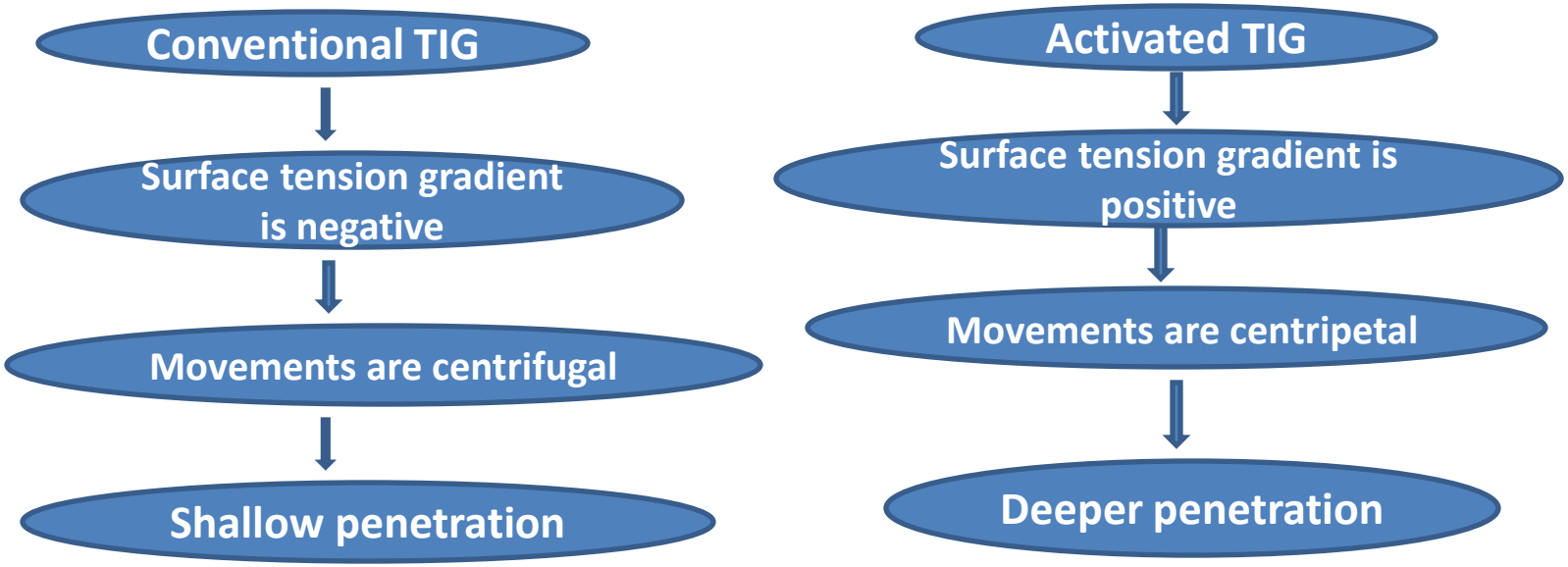
Activated TIG welding

What is Activated TIG?

- Newly developed simple technique for TIG Welding for increased depth of penetration
- It is a powder mixed with a solution and applied a very thin coating on the joint just before TIG welding
- This powder is called as a flux which contains inorganic compounds

Activated TIG mechanism

- Marangoni effect and the arc constriction effect
- The applied activated TIG flux picks up oxygen (0.05%) in weld and cause the molten metal to flow inward and increases the depth of penetration



- The flux acts as a insulating layer reducing the current density at the outer radii of arc column and increases the current density at the center

Application of Activated TIG Flux

- Pressure vessels
- Nuclear Components
- Pipe Joints (thin walled section joints)
- DM water storage tank

For which Material?

Stainless steel of the following types

- AISI 304
- AISI 304L
- AISI 308
- AISI 308L
- AISI 316
- AISI 316L

- Upto 12mm in Single pass with flux application
- For example in 316LN material, dimension 300(L)*125(w)*12(T)

Conventional TIG → **Ten passes**

Activated TIG → **Single pass**

DOP 3mm max at 150A (gets saturated beyond that current) without flux

DOP 12mm at 300A with flux (torch speed 1mm/sec,arc gap 1.5mm)

Disadvantages of Conventional TIG

- Variable weld penetration
- Low welding speed
- Multipass requirement

Advantages of Activated TIG

- Reduced variation in weld penetration
- Single pass up to 12mm thickness (increased penetration and hence productivity)
- Low Heat Input
- Reduced Welding time and cost

TITANIUM TIG welding

Farglory domeTaiwan

Titanium Color Indicates Weld Quality


Figure 1: Silver


Figure 2: Straw


Figure 3: Brown


Figure 4: Brown-blue


Figure 5: Bright Blue


Figure 6: Green-blue


Figure 7: Dull salmon pink


Figure 8: White oxide

Table 2—Color Acceptance Criteria

Weld Color	Quality Indication
Bright Silver	Acceptable[a]
Silver	Acceptable[a]
Light Straw	Acceptable[a]
Dark Straw	Acceptable[a]
Bronze	Acceptable[a]
Brown	Acceptable[a]
Violet	Unacceptable[b, c]
Dark Blue	Unacceptable[b, c]
Light Blue	Unacceptable[b, c]
Green	Unacceptable[b, c]
Gray	Unacceptable
White	Unacceptable

a) Discoloration must be removed prior to additional welding.

b) On the weld and in the HAZ up to 0.03 in. beyond the weld.

c) Violet, blue and green discoloration is rejectable if additional welding is to be performed. Blue and green discoloration is acceptable on finished welds but must be removed prior to subsequent processing.

Note: Discoloration comes in various shades, hues and tones.

Products

- C-Mn Steel
  - TIGFIL 70S-6
  - TIGFIL 70S-2
  - TIGFIL 70S-2 SPL
  - TIGFIL 70S-3

- TIGFIL 70S-G LOW alloy steel High Temperature
  - TIGFIL 70S-A1
  - TIGFIL 80S-B2
  - TIGFIL 80S-B2 SPL
  - TIGFIL 90S-B3
  - TIGFIL 80S-B6
  - TIGFIL 80S-B8
  - TIGFIL 90S-B9

Products

- LOW alloy steel (Low temp)
  - TIGFIL 80S-Ni1
  - TIGFIL 80S-Ni2
- LOW alloy steel High Strength
  - TIGFIL 80S-D2
  - TIGFIL 80S-G
  - TIGFIL 90S-D2
  - TIGFIL 90S-G
  - TIGFIL 100S-G
  - TIGFIL 110S-G

Products

- Stainless Steel
  - Tiginox 308L
  - Tiginox 308H
  - Tiginox 309L
  - Tiginox 309Mo
  - Tiginox 310
  - Tiginox 316L
  - Tiginox 347
  - Tiginox 410
  - Tiginox 410NiMo
  - Tiginox 430
- Duplex Stainless Steel
  - Tiginox 2209
  - Tiginox 2594

Products

- Nickel Alloys
  - Tigfil Ni-1
  - Tigfil NiCr3
  - Tigfil NiCrMo3
  - Tigfil NiCrMo4
  - Tigfil NiCu-7
- Aluminium Alloys
  - Tigfil 1100
  - Tigfil 4043
  - Tigfil 5183
  - Tigfil 5356
- Copper Alloys
  - Tigfil CuNi

Thank You